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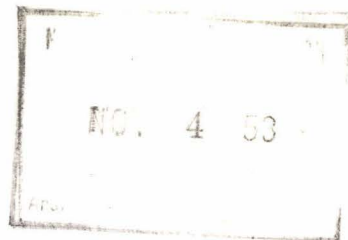
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DEERBRUSH (Sweet birch) IN CALIFORNIA

By

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U. S. Forest Service
Region V

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An eleven-year-old shrub in full bloom.
Sugar pine Stanislaus Forest

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SUMMARY

Forest and brush cover in California are well known for their fluctuating grazing values. National forest grazing policies have been adapted to these conditions of impermanency. Deerbrush, a species that occupies disturbed forests, is, in total, the most important forage plant in part of the ponderosa pine belt in California. In the area of its optimum range more permanent forage types are not significant. However, range units may extend to other elevations with permanent range values that should be considered as key areas in the management of the unit. Over wide areas deerbrush is the significant species and after completing its comparatively short life span the areas revert to more or less waste range in a dense coniferous forest. It often comes in in light stands following the cutting of the forest and in dense stands following destructive fires. It will withstand severe grazing after the second year. It is quite intolerant of shade. The reinvading forest may offer it competition by the 10th year and largely shade it out by the 20th. Only in full sun do many plants survive to the 30th year. Thereafter, its grazing capacity is nil.

The bases for range management in areas where it predominates should include: (1) Judicious grazing for the first and second year; (2) A marked increase in grazing capacity through the third to fifth year; (3) A declining capacity generally after the 10th year; (4) The loss of all plants in fully stocked stands of conifer reproduction by the 20th year; (5) Little or no grazing values elsewhere after the 30th year.

Primary guides for range stocking in order of priority and timing are:

(1) Proper use of any important permanent range values that may be intermingled. In this zone these are usually small wet meadows at the upper elevations of the individual range units; (2) Where there are no permanent range values, soil movement is the primary guide to overstocking; (3) Invading tree reproduction warns of an early reduction in grazing capacity; (4) Age of a deerbrush stand is a basic factor in considering its future management; (5) Range capacity estimates should be revised at least every 5th year.

INTRODUCTION

Deerbrush (*Ceanothus integerrimus*) is one of the most important shrubby forage species in California. It is most abundant in the Ponderosa pine forests on the western slope of the Sierra Nevada Mountains but is also found sparingly, at least, throughout the floristic belt of Ponderosa pine on the west side of the Sierra-Cascade summit and in the coast ranges from near the Mexican border north into Oregon.

It is a "fire type," quickly invading burned areas and largely disappears with the exclusion of fire. It starts from seeds that lay dormant in the litter on the forest floor. It grows vigorously forming a dense cover under optimum conditions and then gives away to the reinvading forest.

As a forage plant it is often found in great quantity and is highly nutritious. Except for the first year or two it withstands the heaviest degree of grazing, but the bulk of the stand eventually grows out of the reach of livestock. For this reason the grazing values decline after the eighth to tenth year and by the thirtieth most of the shrubs have disappeared and those remaining furnish no usable forage. Livestock have, in some years, developed a reaction when grazed in almost pure stands of the shrub.

Due to its high value (up to one annual unit month grazing capacity per acre or more) it frequently has been under study by forest officers. Studies started soon after the National Forests came under administration. The Division of Animal Husbandry of the University of California deemed it of sufficient importance statewide that it initiated studies of its feeding value.

The earliest record of experimental work was that of Forest Examiner L.T. Larsen, who fenced a plot from grazing on the Tahoe National Forest in 1911 and observed a difference in density of deerbrush afterwards outside and inside the plot.

From 1929 to 1942, Range Examiner L. S. Smith on the Tahoe Forest conducted a series of tests and examined a number of areas and reported on deerbrush life history, the effect of fire on its growth and reproduction, grazing management, and pruning methods.

In 1930, Dr. G. H. Hart and the late Dr. H. R. Guilbert of the Division of Animal Husbandry, University of California, reported on the chemical analysis of a series of samples of the shrub collected by L. S. Smith. From 1934 to 1936, in cooperation with the Tahoe National Forest, they conducted grazing tests with cattle in pastures where the shrub furnished a major portion of the forage.

Officers on the Eldorado National Forest, in particular Ranger M. D. Morris, made regeneration and grazing capacity tests on pruned and reburned areas.

On the Stanislaus Forest, Ranger W. H. Spargo conducted tests in a small pasture over a three-year period, determining grazing capacity and weight gains. In 1945, Dr. Erwin Miller, ecologist, was employed by the Forest Service for the summer to make a study of the ecology of the shrub. He reported his findings at the end of the field season. His assistant

Mr. John C. Heinan later enlarged this to a more comprehensive report after a review of Forest Service file material which included a brief report from each of the 18 National Forests in the state as to its distribution, abundance and grazing value.

The California Forest and Range Experiment Station studied laboratory methods for germinating seed.

The writer and others in the Division of Range Management, Forest Service, California Region, gave encouragement and supervision to field projects of forest officers and in addition have worked intimately with range problems in practically all parts of the state where the species is found.

The bulk of the work by forest officers, herein reported, consisted of measurements and observations of unduplicated plots and specific areas, more general observations, and the assemblage of information contributed by stockmen who had long experience in using deer brush ranges.

The ecological work followed a more acceptable experimental routine. The work of the University of California using duplicated pastures was designed properly and added considerable to the knowledge of the grazing problem. However, it dealt with only one age class of the shrub and this was somewhat over the age at which its productivity is highest.

The work as summarized herewith presents what is believed to be sound conclusions as to the ecology, value and management of the species. It should also furnish a sound base upon which to design future experimental work.

DESCRIPTION

Deerbrush ^{1/} is a member of the Buckthorn family (Rhamnacea). It is most widely known as deerbrush, or sweet birch. It is also called mountain lilac, wild lilac, blue brush, buckbrush, rough brush, birch brush, snow brush, and soap brush. It is referred to as lilac because of similarity of the flowers. The name sweet birch is applied to it because of its wintergreen-like flavor similar to that of the true sweet birch, *Betula lenta*. It is called soap brush since the Indians are reputed to have made a type of soap from the flowers.

Deerbrush is a somewhat open, spreading, deciduous shrub up to eighteen feet in height and having slender, graceful, somewhat drooping branches. It is widely branched and often as great in breadth as in height. The growth of the current year is a light yellow-green, the branchlets pliant, and frequently twelve to eighteen inches in length.

The leaves, soft and thin, are ovate to oblong-ovate, entire, and characteristically three nerved from the base. They are one to three inches long, smooth, and lighter green on the underside. They are arranged alternately on the stem.

The flowers are predominantly white, but blue and occasionally pink flowered plants occur. The inflorescence is a panicle three to four inches long. It is compound and usually pyramidal in shape. The seed, a capsule, is nearly

round, up to one-sixth of an inch in diameter, and divided into three lobes, with oblong glands or evanescent crests on the back of each lobe near the middle. The seed is hard, making germination difficult but it remains viable for many years.

It is readily distinguished from other species in the field by its slender pliant branches, tender, entire leaves, quite green color with absence of grayness, and etiolation as summer advances.

DISTRIBUTION

Deerbrush is in greatest abundance along the west slope of the Sierra Nevada Mountains between the Kings River and the Feather. Altitudinally it is confined roughly to the floristic belt occupied by Ponderosa pine. On northward to the McCloud River its range narrows and its occurrence is more patchy.

Beyond these longitudinal limits it occurs more sparingly and does not form the major component of the vegetation. It occurs similarly in the inner ranges of the north coast and in the Sierra Madres of Southern California. Its altitudinal distribution is higher in the south, being found usually above 5,000' in elevation. On the Stanislaus Forest in the Central Sierras it ranges from 3,000' to 5,500'; in the McCloud River drainage from 2,000' to 4,000'.

It is found on each National Forest in the California Region except the Inyo. It may be only a single patch on the Modoc and is rare over much of the Southern California and the central coast ranges due in part to the absence of the proper elevational zone over much of the area.

ECONOMIC IMPORTANCE

Deerbrush is an important and frequently the principal forage species on summer ranges in forested areas in California within its range. It is mainly on ranges occupied by cattle, to a lesser degree by sheep. Deer are consistent users of the browse wherever it exists. It supports a large number of cattle on the Stanislaus, Eldorado, and Tahoe Forests, where it apparently finds its optimum site. It is an important summer forage plant in some localities on the Shasta, Lassen, Plumas and Sequoia Forests. Other forests on the fringe of its range report its being used to various degrees with scattered occurrence and of minor importance in mixed browse stands.

On the Stanislaus Forest where intensive studies were conducted, three grazing allotments embracing a total of 76,000 acres were surveyed intensively. Nearly 35,000 acres or 45% of the area had deerbrush with a density from 5% to 100%. In surface area this was equivalent to 10,555 acres or 13.7% of the total. This quantity of forage on a segment of the range is indicative of the importance of the shrub as summer forage.

PHENOLOGY

New leaves start growth in April or early May and begin flowering in early June. The seed is long in maturing, becoming fully ripe by mid August. On sunny slopes the lower and under leaves become etiolated (begin to lose color) as early as August 1 and begin dropping to the ground a few at a time soon afterwards. This continues until frost completes the process, which may be as late as November, leaving the shrub bare for the winter.

REPRODUCTION

As brought out by Miller,^{3/} reproduction of deerbrush is principally from seed, but stump and root sprouting are natural occurrences. Being a hard seeded plant, the seeds remain viable but dormant on the forest floor for many years. Much seed accumulates during this time but requires some disturbance, such as occurs through forest fires and logging operations. Seed reproduction is rare at other times. Rodents, birds, or other animals show little interest in the seed, but squirrels occasionally plant it as evidence by seedlings appearing in groups.

The heavier stands of deerbrush which now exist are on areas which have been swept by fire within the last thirty years. Lighter stands are found on areas that have been logged during the period. Their density bears a close relationship to the amount of soil disturbance. Miller found the major part of the germination takes place within three years after the initial disturbance. Rarely could any be found that had germinated after the sixth year.

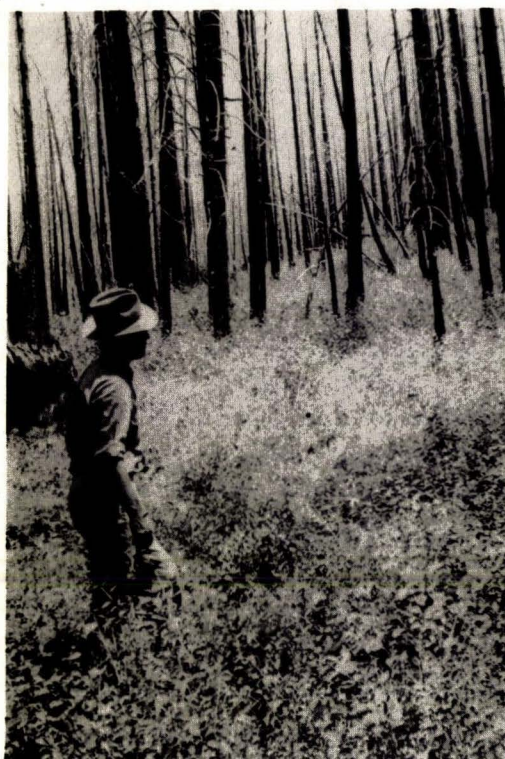
GROWTH

Seedlings reach a height of 3 to 4 inches during the first growing season. The second year's growth usually, but not always, produces two branches besides the leader, the plant averaging 8 inches in height by the end of the season. During the third season it attains its typical branching form, begins to look bushy, and may reach twelve to thirteen inches in height, more in years favorable to growth. During this year the grazing capacity increases markedly and in the next is many times that of the previous years, growing vigorously both in height and breadth often producing stems fourteen inches in length. This rapid growth continues until the tenth to twelfth year on the better sites. It has then reached its maximum size for the site. In some soils it reaches a height of eighteen feet with stems $1\frac{1}{2}$ " to 4" in diameter, branches half drooping and the plant appearing round and full. In such localities, dense stands produce a dense crown with the foliage below shaded out, leaving a barren understory and little foliage for livestock. On thin soils, mature plants may not reach a height of four feet. An unusual shrub, the largest found, was 12.2 inches in diameter with an indicated age of 22 years.

Very few plants were found over thirty-five years of age. Many stands in full sunshine were thrifty at 25 to 30 years of age, but decadent and dying at 30 to 35 years. Scale begins to appear on the shrub at about the twelfth year in many areas. This, in combination with competition and other factors, results in a further thinning of the stand. Re-invading conifer reproduction



One-year-old seedlings.
Milk Ranch burn. Plumas
National Forest.



Three-year-old seedlings. Wrights
Creek burn. Stanislaus National
Forest.



A few vigorous sprouts in a mass of
seedlings. Wrights Creek burn.

offers competition for light and root space over much of the area at the end of ten years and after twenty few survive. Thereafter the plant occurs only in the sun. Here it will die out at about thirty to thirty-five years.

Miller searched for the oldest living specimen on the Stanislaus Forest, counting the annual growth rings of many large mature plants. One forty-seven year old plant was found. Its branches were estimated to be 40% dead; the remainder, though green, and bearing some seed, were not in a vigorous condition. This specimen was six feet high, and nine feet in breadth; the diameter of the largest stem was 4.4 inches at ground level. The plant had not been grazed in recent years, and was in full sunlight, free from competition.

INVASION AND RETREAT

Fires in the Ponderosa pine type are often of such severity that a part of the forest is destroyed and light on the forest floor is markedly increased. Within the range of deerbrush and elsewhere there follows an invasion of shrubs originating partly from sprouts but mainly from a great volume of seed accumulated in the duff on the forest floor. Such species as Bear Clover (*Chamaebatia foliosa*) numerous manzanitas (*Arctostaphylos* spp.) and some species of ceanothus, particularly deerbrush may form pure stands. Miller determined density by a measurement of interception on a number of line transects on various aged burns on the Stanislaus Forest. This is shown in the following table.

Table 1

<u>Name of Burn</u>	<u>Date of Burn</u>	<u>Age of Stand</u>	<u>Density %</u>
Spring Gap	1941	4 yrs.	28.5
Sugarpine	1934	11 yrs.	89.2
Marble Mtn.	1926	19 yrs.	76
Dodge Ridge	1924	21 yrs.	53
Spargo Experimental Plot	1921	24 yrs.	44.1

In 1953, after 32 years, the density of the Spargo plot was less about 5% and a majority of the plants were dead. During the seedling stage and up to the fourth year, the total density of deerbrush remains rather low, but immediately thereafter, it increases rapidly until about the twelfth year when it reaches its maximum. From that period until final disappearance, the stands slowly thin out.

SOILS AND SITES

The shrub is found on almost any well drained soil even though considerable amounts of loose and broken rock are present. Shallow soils support only

light stands and small shrubs. It has been found in scattered patches on sandy soils, and on red clay soils. However, the majority of the sites has a medium soil derived from lava and mixed with rock.

Miller found deerbrush on slopes ranging from 5% to 80% or better with the average slope for good stands being twenty to thirty percent. Except for isolated shrubs, none were found on level ground.

The plant does best on northerly slopes. It is less common on east or south slopes and on the southern part of its range, rare on this aspect. From the Eldorado Forest northward, deerbrush is found more and more on southerly exposures.

ECOLOGICAL RELATIONSHIPS

To Ponderosa Pine

Deerbrush is but a temporary type in the Ponderosa pine forests where it grows almost exclusively in areas where the forest has been partly or totally destroyed either by fire or by logging. In those areas where there are seed trees remaining, incense cedar and ponderosa pine quickly reinvade. At first deerbrush predominates. If a seed year follows the burn or logging, tree reproduction may overtop the deerbrush within eight to ten years. If a seed year is a few years late, young trees are held back and it may be twenty years before they are able to grow up through and above the vigorous deerbrush to attain dominance. In many areas incense cedar may come in first, crowding out the deerbrush, while the pine starts slower, but eventually dominates. Smith ⁴/₄ found the invasion of pine to be more rapid where the soil was well disturbed by livestock grazing. Plantations in deerbrush areas are at times injured by livestock grazing. Sheep on long drives will take the terminal buds of very young pines. Under judicious grazing livestock should not be harmful and could be beneficial to the extent competition is reduced. On benches and near watering places cattle may damage trees up to six feet in height by trampling, rubbing, or hooking. Rarely are they eaten.

To Other Shrubs

Deerbrush is often found growing in combination with manzanita, bear clover, white thorn, gooseberries, grasses, and fern. Competition with these plants as long as they are the same size, or smaller, does not seriously affect ungrazed deerbrush. However, grazing at an early age strongly favors the aggressive non-forage species. Frequently, bear clover and grass grow beneath in more open stands of deerbrush with no apparent effect. The regeneration of most associated shrubs is also encouraged by fire. There are different responses to fires of different intensities as well as burning at different seasons of the year. The meager information on this is discussed later under the heading "Effect of Burning."

Effect of Grazing

Grazing during the first year or two may result in death of the plants or holding them back allowing their less valuable competitors to dominate. Forest

A twelve-year-old stand.
Barton Hill burn. Plumas
National Forest.



Ponderosa pine reproduction
over topping a nineteen-
year-old deerbrush stand.
Sugar pine. Stanislaus
National Forest.



Ponderosa pine has crowded
out a part of a twenty-two-
year-old stand that came in
the Singley burn. Stanislaus
National Forest.

Examiner Larsen noted and photographed this condition on the Tahoe Forest in 1915. A burn was partly planted to pine in 1911 and fenced for protection from livestock. In 1915 Larsen reported "At the present time the oak (*Quercus kelloggii*) and deerbrush within the enclosure are very dense. Over the portion open to grazing there is very little deerbrush and the bear clover is very dense." His photographs show a good stand of deerbrush up to the fence line and practically none outside it except where there was early protection by fallen timber.

Ranger M. D. Morris on the Eldorado Forest found that some judicious grazing could be allowed the second year. However, he has observed repeatedly that small burns and cut-over areas where deerbrush would be expected are sought out by cattle and the seedlings do not survive. Except on large burns he found that fencing or marked reduction in livestock use was needed if a satisfactory stand was to be established. It is probably for this reason that observers have generally concluded the shrub does not become established following timber cutting unless deerbrush is otherwise abundant and not decadent.

Once established having lived through their second year the plants are highly resistant to grazing. On one salting ground on the Rosasco range, Stanislaus Forest, plants 15 years old were completely hedged by cattle and not a leaf extended beyond the old woody stems. On the Sugar Pine holding ground not a leaf remains available to cattle by early summer, yet the shrubs grow profusely. On Dodge Ridge, also on the Stanislaus Forest, cattle kept a twenty-two year old plant down to a height of eight inches, and the plant had all indications of being healthy otherwise and continuing to grow. Heavily grazed plants in open areas on the Plumas Forest appeared thrifty at the age of thirty years, but five years later were mostly dead. Among them were plants whose foliage was mostly out of the reach of cattle, but many of these had succumbed and none were thrifty. The shrubs on the Crandall Peak logging area at the end of thirty-four years were dead or dying except where they were in full sun or without root competition from conifers. It appears that after the second or third year grazing alone will seldom, if ever, kill deerbrush, though it does affect its size, stem diameter, and undoubtedly its vigor.

Effect of Insects

The most important insect is a "scale" which occurs on plants twelve or more years in age. It appears to affect the vitality of the plants, but it is not certain that it alone can cause death. However, many plants which had been heavily grazed, and had scale, were found dead.

On the Plumas Forest the leaves of deerbrush are infested with Chrysomelid beetles (*Ratiosus californicus*). The adults skeletonize outer surfaces of the leaves while the larvae mine between the two surfaces, causing large, brown blister-like areas. Other insects cut leaf edges with a scalloped effect resulting. The only serious effect of either of these insects is probably in older decadent stands.

Effect of Burning

The information on the effect of a reburn of deerbrush is somewhat confusing.

Smith, following a series of observations over a thirteen-year period ending in 1941 on an area burned in 1910, partly reburned in 1924 and again in 1936, concluded that there was a moderate amount of sprouting following the first reburn and a greater amount with less intense fires. All plants die with a second fire. Seeding may be successful with a reburn, but manzanitas and bear clover increase rapidly at the expense of deerbrush with subsequent burns. "Light burning," that is winter fires for clean-up purposes, eliminates deerbrush. On July 7, 1942, Ranger Morris reburned an area of dense deerbrush on the Eldorado National Forest that had been burned in 1924. The shrubs were tall and no foliage had been in reach of livestock for several years. Fuel was added by slashing a thin stand of small pines and cedars that survived the previous fire. This, together with severe burning conditions, resulted in an intense fire consuming most of the plant material on the area and eliminating all of the canopy. There was a very heavy germination the following year, approximately 300,000 seedlings per acre. These were reduced by one-half the following year and numbered about 1500 per acre eight years later.

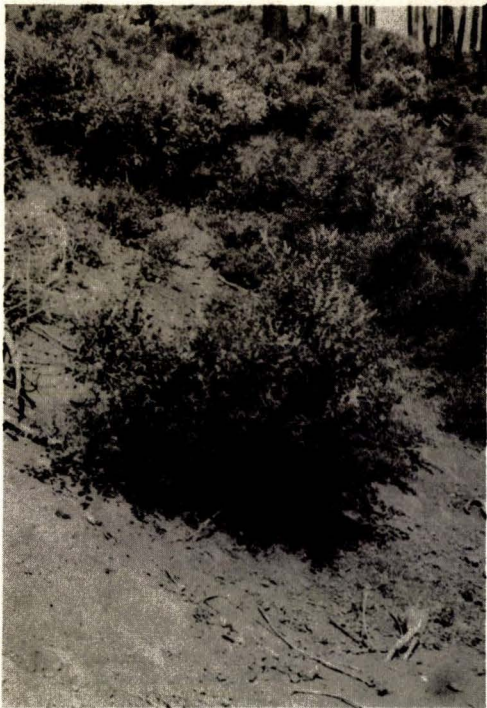
On this intense burn no shrubs sprouted above the ground level. The area was grazed as follows:

1942	No grazing
1943	1.65 cow months per acre
1944	2.15 cow months per acre
1945	1.5 cow months per acre

Basal sprouts grew rapidly reaching a height of 30" and over the following year. They maintained their superiority over those originating from seed through life. Nine years following the burn, they could be easily identified by their size. However, they comprise no more than 5% of the stand. There was a much greater incidence of shrubs originating from sprouts observed where fires were less intense.

On the Stanislaus Forest the plants that were produced by sprouts were quite conspicuous three years following a burn on a good site. They were four to six feet in height and were in full blossom on July 1. The plants originating from seed were growing vigorously but were only two feet high and produced no flowers. Here again the percentage of plants originating from sprouts was quite low.

Ranger Morris concludes that it is most difficult to reburn stands of this species since severe burning conditions are required that raise the cost of insuring the protection of adjoining timbered areas and other values. In addition, such timber values on the area as exist will be eliminated. It would be difficult, if not impossible, to burn stands until several years after their peak value had passed. Thin stands and mixtures with bear clover could not generally be burned satisfactorily, and there is also the further possibility that the stand will give way to less valuable shrubs. Mirov ⁶/₆ reported that in laboratory tests, heat was necessary for germinating seeds of deerbrush. He obtained good results by placing the seed in hot water (180°F) and allowed them to cool over night and planting in the fall or stratifying for spring planting. Scarification or acid treatment of the seed coat had no apparent effect.



A fifteen-year-old stand on thin soil. Spring Gap burn. Stanislaus National Forest.



Ranger Spargo's experimental pasture at the end of thirty-two years.



A few old shrubs remain in the openings of the Crandall Peak cut-over area after thirty years.



Another view of Ranger Spargo's pasture.

3/

In 1926, L. S. Smith collected seeds in forest litter, burned part with litter and planted a plot each of burned and unburned seed. No seed germinated on the unburned plot. Several seeds germinated on the burned plot.

There was no additional germination in the three following years that the plots were under observation.

On the Stanislaus Forest the number of plants counted on the various burns studied were as follows:

Table 2

<u>Name of Burn</u>	<u>Year Burned</u>	<u>Plants Per Acre</u>	<u>Age of Stand</u>	<u>Ring Counts</u>	<u>Predominant Age</u>
Spring Gap	1941	19,300	4	2-4	4
Sugarpine	1934	10,300	11	6-11	11
Marble Mtn.	1926	1,900	19	11-18	18
Dodge Ridge	1924	3,150	21	7-19	19
Spargo Exp. Plot	1921	1,690	24	20-24	21

Counts on the Eldorado Forest found approximately 1500 and 1000 plants per acre on nine and seventeen year old burns respectively.

Effect of Logging

Miller found deerbrush reproduction coming in on logged over areas where the soil had been violently disturbed such as on skidways, tractor roads, truck roads, and railroad grades.

Where mature plants were broken off at ground level in logging operations, a vigorous crop of stump sprouts resulted. With the lighter cutting in present day logging and less destructive methods, only light stands of deerbrush result. Because travel routes follow areas of disturbed soil, the casual estimate of the amount of deerbrush on cut-over areas exceeds the amount actually present. Transects show that other plants, mainly manzanita, white thorn, and bear clover predominate.

Plant counts made on a series of transects on the Stanislaus Forest on logged sites showed the following:

<u>Location of Area</u>	<u>Year Logged</u>	<u>Plants per Acre</u>	<u>Predominant Age</u>
Cherry River	1944	3,100	1
Cherry River	1943	1,900	1
Woods Ridge	1942	2,500	3
Crandall Peak	1922	1,300	19

Counts on Woods Ridge in 1945, logged in 1942, showed only 2,500 plants per acre as compared to the Spring Gap burn of 1941 nearby which had 19,300 plants per acre. While the invasion of deerbrush on logged areas is not as spectacular as on a destructive burn, the resulting forage stand is of definite value and careful management is justified.

Effect of Pruning

Pruning mature deerbrush will result in the production of vigorous sprouts making a stand once again a useful grazing type. Associated with the burning test on the Eldorado Forest above described, Ranger Morris, in February, 1941, pruned an adjoining area of two acres of the same 1924 burn, cutting all branches to within one foot of the ground. All of the shrubs sprouted vigorously, about 90% being basal sprouts, the remainder from the stump. (This indicated the stumps may be cut much lower, if convenient.) Few stump sprouts lived through the second year. On the other hand, nearly all basal sprouts remained alive and grew vigorously. Nine years later practically every shrub was still alive and had some available forage. They numbered about 1,000 per acre. It is less dense than the adjoining reburned area, having the density of a seventeen year old stand (its age when pruned) as compared with nine years, the age of the portion of the stand that was burned. In addition, there is a 10% canopy of trees over the area pruned which probably thins the stand by this amount. The area was grazed as follows:

1941	No grazing
1942	1.75 cow months per acre
1943	2.6 cow months per acre
1944	1.75 cow months per acre
1945	2.00 cow months per acre

It was found that for dense stands ten years or more in age, complete pruning involved about two man days labor per acre, or a cost of \$20 or more. Since any pruned areas will be small, livestock must be removed by fencing or otherwise.

Ranger Morris recommends re pruning about every tenth year since grazing values begin to drop rapidly at that time.

Grazing Value

The plant has many of the attributes of an ideal forage plant. It is nutritious; widespread; abundant; has high grazing capacity; and is highly resistant to livestock use, more so than the soils that support it. Like other forage, its palatability is governed considerably by weather conditions of the year, the geographic situation, and the period it is used.

Observers report uniformly that the plant is less palatable on drier sites. Similarly in dry years the plant loses its value on most sites earlier in the season.

The seeds are important feed in late summer. In years of little seed production livestock gains may be considerably reduced. Hart et al 2/ reported "Palatability becomes noticeably lowered after the seeds are formed and are falling."

Due to heavy cover in timber and brush, the deerbrush area is not commonly used by sheep. Nevertheless, it is relished in mid-summer by them and satisfactory

lamb weights are obtained in younger stands if otherwise usable.

It is important as forage for deer in summer. Twigs are used in winter on ranges selected by deer for that period. However, heavy snows will force deer to elevations below which the species occurs. On the other hand, most deer summer above the deerbrush zone. The discussion that follows will be related to cattle grazing, the dominant livestock use.

One phase of the problem was outlined by Hart et al of the University of California (1937) as follows:

Interest was attracted to this important plant by the fact that it began to lose its palatability in the latter part of the summer when there still remained an ample supply of it. At this time cattle tend to wander about in search of other forage, which is scarce, and rapidly lose the gains made earlier in the season.

In 1930 samples of this browse were collected at about three-week intervals for chemical analysis beginning May 28 and ending September 19. (Hart, Guilbert and Goss, 1932). The shrubs were six years old at the time.

They found that with advancing stages of maturity the protein decreases from a high of 28% or better to a low of about 13%. The phosphorus content declined to around 0.13% and the calcium phosphorus ratio changes from around four in the spring to eighteen or higher in the fall. The fiber content of the leaves was comparatively low even at the end of the season. The exact explanation for the low palatability at the latter part of the summer is not apparent from ordinary analysis except for the existence of the wide calcium-phosphorus ratio. In poor feed seasons particularly a peculiar syndrome develops late in the season in a varying percentage of cattle on these areas that is known locally as the "Jimmies." In this condition animals, although losing weight, will be scattered out on the range and appear normal when a rider comes in sight of them. If driven at a normal pace and particularly if hurried, they begin to tremble, have difficulty in walking, show great excitement, and if crowded will go down with convulsions and even die. On the other hand, if left to stand or lie quietly where they are when the symptoms first appear, they will improve and in a few hours may be slowly started and driven many miles without further acute symptoms. It occurs in cattle of all ages and many local explanations have been given for the condition, none of which have been substantiated. Evidence indicates that prolonged browsing on sweet birch may be connected with its development, and that it is associated with feed conditions in the area.

The University began intensive studies in 1933. Following a plan developed cooperatively with the U. S. Forest Service, two comparable areas were enclosed on the Tahoe National Forest. Each consisted of approximately 640 acres on the Sugar Pine range on the Forest Hill Divide at an elevation

of about 4,000 feet. Holding corrals were constructed and weighing devices installed. During the three years, 1934 - 1936, the pastures were stocked to near their grazing capacity with cattle. Periodically they were weighed and blood serum-phosphorus determinations were made. Chemical analyses were made of deerbrush and its saponin and tannin content determined.

The summary continues:

While the low palatability of the ceanothus browse beginning in August coincides with the low phosphorus content and the widening calcium phosphorus ratio, this plant also develops an increasing amount of saponin as the season advances which is now known to be toxic for animals. This is also a tenable reason for its lowered palatability and possibly an explanation for the development of the condition known as "Jimmies." No cases of this condition occurred in 1935 or 1936 when animals were in the area 115 days and 119 respectively and feed conditions were relatively good.

A number of cases occurred in 1934 when the animals were in the area 132 days and the feed conditions were very poor.

The losses in weight of the cows after September 15 in all three years renders it doubtful if they should remain there after this date.

The study was discontinued after 1936, 11 years after the burn, due to the invasion of pine and cedar reproduction and to the fact the browse was then mostly out of reach of cattle.

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Ranger Spargo in 1934 fenced a 4.4 acre pasture on the Stanislaus Forest enclosing a nearly pure stand of the shrub, then thirteen years of age. Three animals (one yearling and two 2-year-old steers) grazed in it 87 days in 1934. Four two-year-old steers grazed it 94 days in 1935 and five two year olds for 100 days in 1936. Weights were estimated by experienced stockmen when the stock entered and left the pasture. The indicated gain per head per day was 1.8 pounds in 1934, 1.9 in 1935, and 0.7 in 1936. In the latter year the light gain is attributed to the fact there was no seed crop. The method of securing weights cannot be considered acceptable for experimental purposes; however, most of the animals were in slaughter condition at the end of the season. Photographs show they were quite sleek and fat. The owner was well satisfied.

The forage was not heavily used at the end of any year. The average rate of stocking was three steers per acre per month. Smith reported similar results with a stocking of one head per acre per month in the larger and lower value experimental pastures on the Forest Hill Divide.

Good stands of deerbrush at the peak of production can be stocked heavier than Forest Hill pastures. However, only the usable area and area actually covered by the shrub can be used in computing the number of livestock to be assigned an area. Losses in weight of cows after September 15 in all of the studies showed that that date is probably the limit to which livestock should remain on this type of range.

Value in Relation to Age

At about the third growing season, deerbrush reaches sufficient size to be utilized. From the third or fourth year on, it can be heavily grazed without apparent injury, the amount of utilization eventually being limited to what can be reached by the livestock. Except on shallow soils a large part of those plants that are not kept short by heavy grazing grow out of reach of cattle in eight to ten years. However, cattle on occasions ride such brush down in order to get at the foliage. This practice seems to occur on sites with a slope of 25 to 40 percent and on areas just below hillside benches. In the areas that remain open and are moderately grazed, some forage is produced that is within reach of livestock as long as the plant lives. Older shrubs are not taken with as much relish as young thrifty ones.

Value in Relation to Topography

Deerbrush is frequently found in places too far from water, and more often in rough areas and steep mountain hillsides where cattle hesitate to go. It often grows in relatively dense stands on slopes over 60%, but in such situations will not be used by cattle. In fact, cattle prefer not to graze somewhat gentler slopes if there are no convenient places to lie down to ruminate. As a result, uniform slopes of considerable size are not grazed unless forage is quite short on the remaining parts of the range. Many fine stands of deerbrush on slopes above 40% should be lightly used.

Management

Deerbrush is a temporary forage type in a most important commercial timber belt. The problem of making use of the grazing values is secondary to that of restoring the forest. These objectives, however, are not incompatible. Livestock is usually helpful in the natural reproduction of the species of conifers desired. Judicious grazing is not harmful to young trees except possibly in small areas where cattle naturally concentrate. If a selection is to be made in areas that are to be planted to trees, planting may be deferred on benches and near watering places; otherwise, there may be a need to exclude livestock by fencing.

Deerbrush, particularly where small burns or cut-over areas are involved, needs almost complete protection for one and possibly two years following the fire or cutting. This is due not only to its lack of resistance to grazing then, but to the tendency of livestock to concentrate on such new areas, and to the need for allowing the shrubs to obtain a competitive advantage over equally aggressive but less valuable plants.

Among the multitude of problems stockmen have in dealing with brush in California, the method of keeping deerbrush from growing out of reach is often present. The most commonly recommended solution has been to graze it heavily to keep it down. Observations directed towards this found:

- (1) Close grazing keeps the stands of brush open and prevents the development of impenetrable thickets;
- (2) Results in severe soil loss on the steeper slopes (over 25 or 30%, less on certain soils);
- (3) Limits livestock gains;
- (4) Does not control height

growth except on small areas where livestock naturally concentrate;
(5) Did almost irreparable damage to intermingled types and species,
permanent in character; (6) Speeded natural regeneration of forest
trees.

It was concluded that the control of height growth by grazing was not feasible and that management should be directed toward the optimum condition of livestock and maximum meat production coordinated with a range management program that would:

(1) Open up the type; (2) Protect the soil, recognizing that some soil movement may be tolerated due to the temporary character of the use; and (3) Protect types and species, permanent in character, should the range be economic to use when the value of deerbrush disappears.

The range manager, in planning for the use of fast growing stands of deerbrush, should first consider the intermingled forage types and species, the natural openings, meadows and stringers, and determine the degree of protection required.

The use of the usual degree of caution in planning for stocking about the third year and after is not indicated. Thereafter soil movement should be the guide. The intensive use of these high capacity areas will disturb the light dry soils and some movement cannot be avoided. If, however, erosion channels start that will carry soils away from an area, use should be considered too heavy. This degree of use is lighter than is commonly practiced.

At the end of the tenth year following a burn or logging, grazing capacities should have reached their peak with plants on the good sites growing out of reach and tree reproduction beginning to shade out many areas.

From the tenth to the twentieth year grazing capacities will be maintained only in patches of the shrub growing in full sun. During this period plants in part shade or suffering root competition start to die and produce less and less forage. Soil loss may become more conspicuous in openings on fully stocked ranges.

At the end of this period capacities are principally those of the open areas where the plant enjoys full sun.

At the end of thirty years those remaining shrubs in the open, grazed or ungrazed, lose any semblance of healthy appearance and while close grazing may have hastened their demise, all shrubs rapidly disappear within the next few years. At forty years, trees have taken over nearly all sites, but two score years is beyond the average life span of the shrub and a most careful search may not reveal a single specimen of the once-abundant plant that occupied the site.

Studies of the possibilities of pruning should be continued. Ranges that will approach irrigated pastures in capacity are worthy of a considerable investment for their maintenance. Some acres would justify a total rental value excess of \$50. The investment of a portion of this in extending their usefulness would be prudent providing the area is not being recaptured by pines.

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